

CPUE

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Hypothesis

- 1) H_0 : There is no difference in cpe (catch/hour) among years 2013 - 2016.
- 2) H_0 : There is no differenc^t in cpe for quality length (300mm) and larger largemouth bass among years 2013 - 2016.
- 3) H_0 : There is no difference in cpe for largemouth bass smaller than quality length (300mm) among years 2013 - 2016.

1) H_0 : There is no difference in cpe (catch/hour) among years 2013 - 2016.

Load and Prepare Data

Load Data

```
gcat <- read.csv("Data/Clean-Data/CPUE-gcat_2013-2016.csv") %>% filter(Species == 317) %>% arrange(Site, Year)

gcat$Site <- factor(gcat$Site)

cpeSum <- aggregate(cpe.hr ~ Year + Site, data = gcat, FUN = sum)
```

Year	Site	cpe.hr
2014	1	45.378151
2013	2	86.746988
2014	2	87.032967
2015	2	19.169329
2016	2	59.602649
2013	4	58.009479
2014	4	19.933555
2015	4	31.259045
2016	4	48.949320
2015	5	4.225352
2013	6	4.712042
2014	6	21.021898
2015	6	17.716535
2016	6	44.628099
2013	8	38.709677
2014	8	47.787611
2015	8	117.249698
2016	8	166.591422
2013	10	20.571429
2014	10	27.799228
2016	10	5.872757

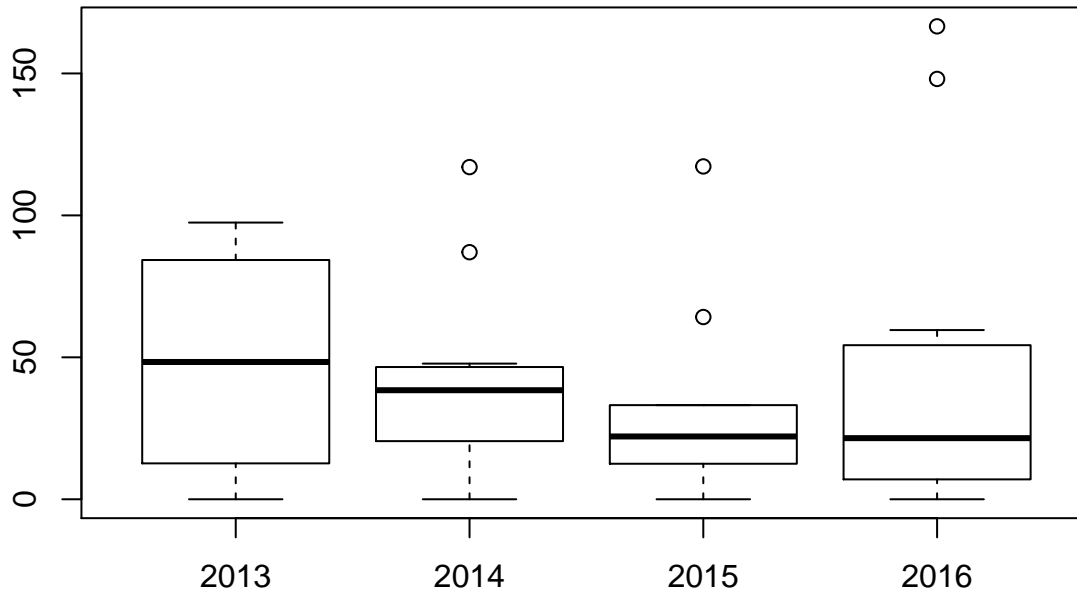
	Year	Site	cpe.hr
22	2014	11	117.009751
23	2015	11	33.162743
24	2016	11	26.438188
25	2014	12	36.468886
26	2015	12	12.514484
27	2016	12	10.404624
28	2016	13	0.000000
29	2016	14	8.135593
30	2013	15	81.818182
31	2014	15	40.346409
32	2015	15	25.079164
33	2016	15	16.618581
34	2014	16	45.120859
35	2013	18	97.472924
36	2014	18	16.775396
37	2015	18	64.197531
38	2016	18	148.064516
39	2013	19	0.000000
40	2014	19	0.000000
41	2015	19	0.000000
42	2016	19	0.000000

Test Hypothesis 1

```
aov1 <- aov(cpe.hr ~ Year, data = cpeSum)
summary(aov1)
```

```
##           Df Sum Sq Mean Sq F value Pr(>F)
## Year       1    121   121.3    0.071  0.792
## Residuals 40  68501   1712.5
```

Mean Catch Per Hour



Results H_0 1

There is *no significant difference* in CPUE between years ($F_{1,40} = 0.071$, $p = 0.792$).

2) H_0 : There is no difference in cpe for quality length (300mm) and larger largemouth bass among years 2013 - 2016.

Load and Prepare Data

Load Data with Gcat and make Q+ and Q-

```
##      Year Site  effort Species      gcat caught  cpe.hr
## 1  2014    1 0.2644444    317    stock      9 34.03361
## 2  2014    1 0.2644444    317  quality      3 11.34454
## 3  2014    1 0.2644444    317 substock      0  0.00000
## 250 2016   19 0.2322222    317 preferred      0  0.00000
## 251 2016   19 0.2322222    317 memorable      0  0.00000
## 252 2016   19 0.2322222    317   trophy      0  0.00000

##      Year
## gcat  2013 2014 2015 2016
## memorable  0   0   0   0
## preferred 14  18  15  10
## quality   39  57  38  47
## stock     38  65  14  53
## substock  16   3  13  34
## trophy    0   0   0   0
```

Make Qcat Variable and Data Frame

```
Qcat <- gcat %>% mutate(gcatQ = mapvalues(gcat, from = c("substock", "stock",  
  "quality", "preferred", "memorable", "trophy"), to = c("quality-", "quality-",  
  "quality+", "quality+", "quality+", "quality+"))) %>% dplyr::select(Year,  
  Site, gcatQ, cpe.hr)
```

Create Data Frame With Only Quality + Fish

```
Qpls <- Qcat[Qcat$gcatQ == "quality+", ]  
Qpls$gcatQ <- droplevels(Qpls$gcatQ)
```

```
str(Qpls)
```

```
## 'data.frame': 168 obs. of 4 variables:  
## $ Year : int 2014 2014 2014 2014 2013 2013 2013 2013 2014 2014 ...  
## $ Site : Factor w/ 15 levels "1","2","4","5",...: 1 1 1 1 2 2 2 2 2 2 ...  
## $ gcatQ : Factor w/ 1 level "quality+": 1 1 1 1 1 1 1 1 1 1 ...  
## $ cpe.hr: num 11.3 0 0 0 23.7 ...
```

```
Qpls.sum <- aggregate(cpe.hr ~ Year + Site, data = Qpls, FUN = sum) %>% arrange(Site,  
  Year)
```

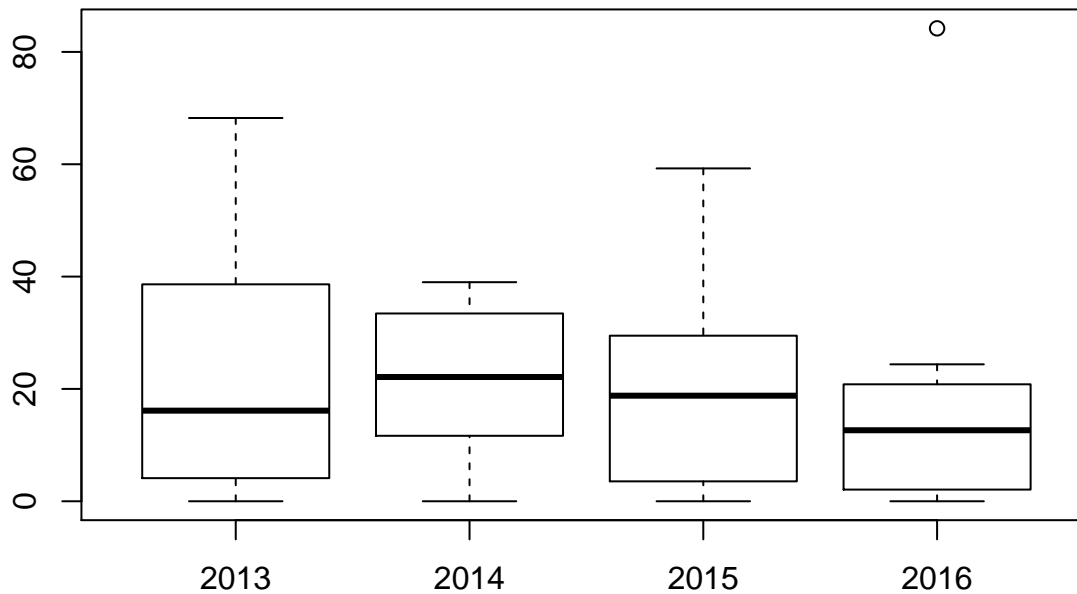
Year	Site	cpe.hr		Year	Site	cpe.hr
2014	1	11.344538	22	2014	11	39.003250
2013	2	23.658269	23	2015	11	29.477994
2014	2	35.604396	24	2016	11	17.625459
2015	2	0.000000	25	2014	12	31.259045
2016	2	23.841060	26	2015	12	12.514484
2013	4	23.886256	27	2016	12	10.404624
2014	4	11.960133	28	2016	13	0.000000
2015	4	26.049204	29	2016	14	0.000000
2016	4	17.799753	30	2013	15	53.359684
2015	5	4.225352	31	2014	15	22.007132
2013	6	0.000000	32	2015	15	25.079164
2014	6	15.766423	33	2016	15	4.154645
2015	6	3.543307	34	2014	16	38.675022
2016	6	14.876033	35	2013	18	68.231047
2013	8	8.602151	36	2014	18	10.065238
2014	8	23.893805	37	2015	18	59.259259
2015	8	52.110977	38	2016	18	84.193548
2016	8	24.379233	39	2013	19	0.000000
2013	10	8.228571	40	2014	19	0.000000
2014	10	22.239382	41	2015	19	0.000000
2016	10	5.872757	42	2016	19	0.000000

Test Hypothesis 2

```
aov.Qpls <- aov(cpe.hr ~ Year, data = Qpls.sum)  
summary(aov.Qpls)
```

```
##           Df Sum Sq Mean Sq F value Pr(>F)  
## Year      1    208   207.5    0.515  0.477  
## Residuals 40  16111   402.8
```

Mean Catch Per Hour Quality +



Results H_0 2

There is *no significant difference* in CPUE for fish > Quality length (300mm) among years 2013 - 2016 ($F_{1,40} = 0.515$, $p = 0.477$).

3) H_0 : There is no difference in cpe for largemouth bass smaller than quality length (300mm) among years 2013 - 2016.

Load and Prepare Data

Create Q- Data Frame

```
Qless <- Qcat[Qcat$gcatQ == "quality-", ]
Qless$gcatQ <- droplevels(Qless$gcatQ)
```

```
str(Qless)
```

```
## 'data.frame': 84 obs. of 4 variables:
## $ Year : int 2014 2014 2013 2013 2014 2014 2015 2015 2016 2016 ...
## $ Site : Factor w/ 15 levels "1","2","4","5",...: 1 1 2 2 2 2 2 2 2 2 ...
## $ gcatQ : Factor w/ 1 level "quality-": 1 1 1 1 1 1 1 1 1 1 ...
## $ cpe.hr: num 34 0 35.5 27.6 11.9 ...
```

```
Qless.sum <- aggregate(cpe.hr ~ Year + Site, data = Qless, FUN = sum) %>% arrange(Site,
  Year)
```

Year	Site	cpe.hr
2014	1	34.033613
2013	2	63.088718
2014	2	51.428571
2015	2	19.169329
2016	2	35.761589
2013	4	34.123223
2014	4	7.973422
2015	4	5.209841
2016	4	31.149567
2015	5	0.000000
2013	6	4.712042
2014	6	5.255475
2015	6	14.173228
2016	6	29.752066
2013	8	30.107527
2014	8	23.893805
2015	8	65.138721
2016	8	142.212190
2013	10	12.342857
2014	10	5.559846
2016	10	0.000000

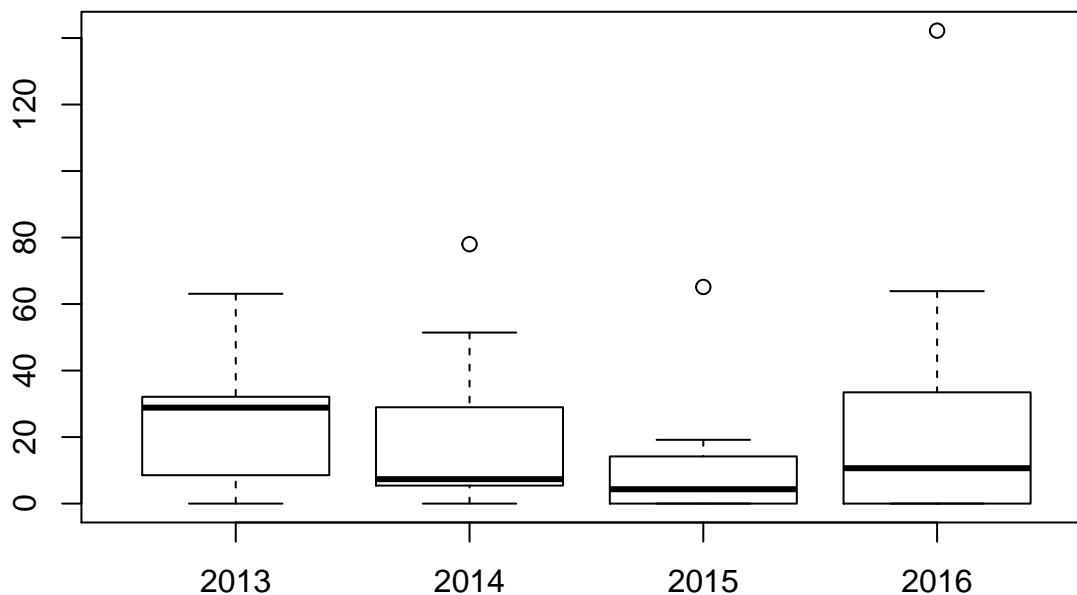
	Year	Site	cpe.hr
22	2014	11	78.006501
23	2015	11	3.684749
24	2016	11	8.812729
25	2014	12	5.209841
26	2015	12	0.000000
27	2016	12	0.000000
28	2016	13	0.000000
29	2016	14	8.135593
30	2013	15	28.458498
31	2014	15	18.339277
32	2015	15	0.000000
33	2016	15	12.463935
34	2014	16	6.445837
35	2013	18	29.241877
36	2014	18	6.710158
37	2015	18	4.938272
38	2016	18	63.870968
39	2013	19	0.000000
40	2014	19	0.000000
41	2015	19	0.000000
42	2016	19	0.000000

Test Hypothesis 3

```
aov.Qless <- aov(cpe.hr ~ Year, data = Qless.sum)
summary(aov.Qless)
```

```
##              Df Sum Sq Mean Sq F value Pr(>F)
## Year          1    12      11.5   0.014  0.906
## Residuals    40  32690      817.2
```

Mean Catch Per Hour Quality–



Results H_0 3

There is *no significant difference* in CPUE for fish < Quality length among years 2013 - 2016 ($F_{1,40} = 0.014$, $p = 0.906$).

